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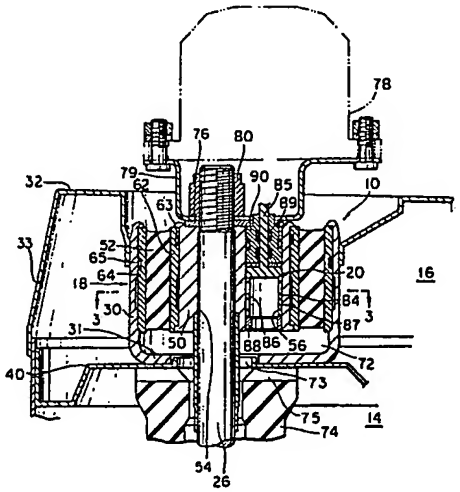
(54) Construction of control valve for air suspension.

(57) A construction of a control valve for an air suspension having main and auxiliary air chambers (14, 16) comprises a boundary member (18) disposed between the main and auxiliary air chambers (14, 16) and provided with a path for communicating both air chambers and a valve body (20) disposed in the path. The path or the valve body includes a first path portion (57, 87) and a second path portion (58, 91) having a bore smaller than that of the first path portion. A perforted member (82) is provided in relation with the second path portion of the path or valve body.



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CONSTRUCTION OF CONTROL VALVE FOR AIR SUSPENSION

BACKGROUND OF THE INVENTION

Field of the Invention:

This invention relates to a construction of a control valve for an air suspension.

Description of the Prior Art:

Some air suspensions have a main air chamber formed to surround an upper portion of a shock absorber and an auxiliary air chamber, both air chambers being filled with compressed air to constitute an air spring while affording and interrupting communication between the main air chamber and the auxiliary air chamber through a valve body to change the volume of air chambers so that the spring constant of the air spring can be adjusted.

In said air suspension, when the valve body is held at the communicating condition, the volume of the main air chamber is increased and decreased along the abrupt vertical movement of the shock absorber due to the force from a road surface to provide the high speed inflow and outflow of air through a path. Therefore, flow sounds may occur to give an uncomfortable feeling.

SUMMARY OF THE INVENTION

The Utility Model Application No. 108857/84

proposed in consideration of the above mentioned relates to a control valve construction for affording and interrupting communication between the main and auxiliary air chambers of an air suspension, which comprises a first perforated member having a plurality of holes opening to said main air chamber, a second perforated member having a plurality of holes opening to said auxiliary air chamber and disposed from said first perforated member through a path and a valve body disposed in said path to afford and interrupt communication to the path.

Now, there is proposed an air suspension in which a path having a plurality of path portions with different bores is provided between the main and auxiliary air chambers to not only afford or interrupt communication between both air chambers, but also change the flow speed of air when both air chambers communicate to each other so that a dynamic spring constant can be adjusted to the soft and hard ones. In this air suspension, when the dynamic spring constant is to be softened, the flow speed needs to be reduced by expanding the area of the path portion as large as possible. However, if a perforated member is disposed in the path portion, air flow is throttled by the perforated member to increase the flow speed so that the dynamic spring constant cannot be softened to the predetermined one.

On the other hand, according to facts confirmed experimentially, when the dynamic spring constant is to be hardened, i.e., air flows through the path portion having a small bore, abnormal sounds take place.

An object of the present invention is to provide a control valve construction for an air suspension which gives no troubles to air flow when the air flows through a path portion having a large bore and can restrain the abnormal sounds when the air flows through a path portion having a small bore.

According to the present invention, a control valve construction for an air suspension having main and auxiliary air chambers comprises a boundary means disposed between the main and auxiliary air chambers and provided with a path for communicating both air chambers and a valve body disposed in said path. The path has a first path portion and a second path portion having the bore smaller than that of the first path portion, or said valve body has a third path portion and a fourth path portion having the bore smaller than that of the third path portion. A perforated member is provided in relation with said second path portion or the fourth path portion.

According to the present invention, since the perforated member is disposed in the hole of path portion having the small bore of path or valve body, the occurrence of abnormal sounds can be prevented in the

air flow through the hole without giving any uncomfortable feeling to passengers. Also, since the perforated member is absent in the hole of path portion having the large bore, the flow speed can be reduced as low as possible in the air flow through this hole and the dynamic spring constant can be held at the predetermined soft one. Thus, a better ride comfort can be provided.

BRIEF DESCRIPTION OF THE DRAWING

The other objects and features of the invention will become apparent from the following description of preferred embodiments of the invention with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view showing a control valve construction;

Fig. 2 is a sectional view showing an air suspension incorporating the control valve construction;

Fig. 3 is a sectional view taken along the line 3-3 in Fig. 1; and

Fig. 4 is a sectional view similar to that in Fig. 3, showing a further embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in Figs. 1 and 2, a control valve construction 10 is constituted from a boundary means 18

disposed between a main air chamber 14 and an auxiliary air chamber 16 of an air suspension 12 and a valve body 20 disposed in the boundary means 18.

In the embodiment shown, the main and auxiliary air chambers 14,16 are formed to surround an upper end of a shock absorber 22 and filled with compressed air to constitute an air spring.

The shock absorber 22 which is well known per se is provided with a cylinder 24, a piston (not shown) and a piston rod 26 connected to the piston to project from the cylinder 24 to the outside. The shock absorber 22 is connected to a suspension arm (not shown) on a lower end.

A housing 28 for forming the air chamber has a flat annular ceiling portion 32 welded on an inner peripheral edge to the whole periphery of a cylindrical member 30 of the boundary member 18, a first tubular portion 33 integrally extending from the ceiling portion and a second tubular portion 34. A plurality of bolts 36 (only one of them is shown in Fig. 2) welded with airtightness to the ceiling portion 32 of the housing 28 extend through a car body 38 and nuts 37 are screwed onto the bolts 36 to connect the housing 28 with the car body 38. To the whole periphery of the first tubular portion 33 of the housing 28 is welded an outer peripheral edge of a partition 40. An inner peripheral edge of the partition 40 is welded to the whole

periphery of a flange 31 of the cylindrical member 30. The second tubular portion 34 of the housing 28 is fitted onto the first tubular portion 33 and welded thereto over the whole periphery.

A diaphragm 42 is formed of cylindrical rubber and folded back at an approximately middle portion so that outside and inside ends are fixed respectively to the second tubular portion 34 of the housing 28 and a cylindrical air piston 44 welded to the cylinder 24. As a result, the main and auxiliary air chambers 14,16 are defined respectively beneath and above the partition 40.

The boundary means 18 is provided with a valve receiving body 50 formed of rigid material, a bushing 52 formed of rubber and said cylindrical member 30 formed of rigid material. In the embodiment shown, the boundary means 18 holds the valve body 20 for affording and interrupting communication between the main and auxiliary air chambers 14,16 while serving to support the piston rod 26.

As shown in Fig. 3, the valve receiving body 50 is provided with a hole 54 through which the piston rod 26 extends, a hole 56 extending parallel to the hole 54 for receiving the valve body 20, a pair of holes 57 extending toward an outer peripheral surface diametrally from the hole 56 and a hole 58 spaced circumferentially from a pair of holes 57, extending from the hole 56 toward an outer peripheral surface and having a small

bore. To the outer portion of the hole 58 is connected a hole 59 having an enlarged bore. One of pair of holes 57 is connected to a notch 60 and the other of pair of holes 57 and the hole 59 are connected respectively to a notch 61.

The bushing 52 is vulcanized and bonded to inner and outer tubes 62,64. The valve receiving body 50 is press fitted in the inner tube 62 mounting an O-ring 63, and the outer tube 64 mounting an O-ring 65 is press fitted in the cylindrical member 30. The inner tube 62 has a groove 66 extending around the whole periphery at a position of an inner peripheral surface opposed to the notches 60,61 of the valve receiving body 50 and holes 67 extending from the groove 66 to an outer peripheral surface. The bushing 52 has holes 68 extending from an inner peripheral surface to an outer peripheral surface at positions opposed to the respective holes 67 of the inner tube 62, and the outer tube 64 has holes 69 extending from an inner peripheral surface to an outer peripheral surface at positions opposed to the respective holes 68 of the bushing 52. The cylindrical member 30 has a groove 70 extending around the whole periphery at a position of an inner peripheral surface opposed to the holes 69 of the outer tube 64 and holes 71 extending from the groove 70 to an outer peripheral surface.

The holes 71 of the cylindrical member 30 open to

the auxiliary air chamber 16. On the other hand, the hole 56 of the valve receiving body 50 opens to a space 72 surrounded by the flange 31 of the cylindrical member 30 and communicating to the main air chamber 14 through a gap 73 between the flange 31 and the piston rod 26 and a hole 75 provided in a bound stopper 74. As a result, a path from the main air chamber 14 to the auxiliary air chamber 16 is constituted from said various holes provided in the boundary member 18.

The piston rod 26 extends through the hole 54 of the valve receiving body 50, a washer 76 and a bracket 79 of an actuator 78 are disposed on the upper side of said body 50 and a nut 80 is screwed onto the piston rod 26 to connect the piston rod 26 with the valve receiving body 50.

A perforated member 82 is disposed in the hole 59 of the valve receiving body 50 to restrain the occurrence of abnormal sounds when air flows through the hole 58 having the small bore. The perforated member 82 is provided with a plurality of holes extending in the axial direction of the hole 58.

The valve body 20 has integrally a slide portion 84 and an operating portion 85 extending upward, the slide portion 84 being provided with a recess 86 and holes 87 extending radially from the recess to an outer peripheral surface. The recess 86 opens to the space 72 and the holes 87 can communicate to the holes 57,58 of

the valve receiving body 50. The valve body 20 is inserted in the hole 56 of the valve receiving body 50 and rotatably held in the hole 56 with airtightness by a cylindrical holder 88 press fitted in the lower portion of the hole 56 and a holder 90 disposed in the upper portion of the hole 56 and having O-rings 89 mounted on inner and outer peripheral surfaces. An output shaft of the actuator 78 well known per se and consisting of a motor and a reduction gear is non-rotatably connected with the operating portion 85 of the valve body 20.

When the valve body 20 is located in the interrupting position shown in Fig. 3, only the main air chamber 14 is subjected to spring action so that the spring constant of the air spring is large. When the valve body 20 is rotated by 60°, the main air chamber 14 communicates to the auxiliary air chamber 16 through a pair of holes 57 of large path portions and then since the pair of holes 57 resist little to air flow, the spring constant of the air spring is small. When the valve body 20 is rotated further by 60°, the main air chamber 14 communicates to the auxiliary air chamber 16 through the hole 58 of small path portion. Since the hole 58 then gives large resistance to the air flow, the spring constant of the air spring is medium.

In the embodiment shown in Fig. 4, the valve receiving body 50 has a pair of holes 57 extending from

the hole 56 to the outer peripheral surface. On the other hand, the valve body 20 disposed in the hole 56 has the recess 86, the holes 87 extending from the recess 86 to the outer peripheral surface and a hole 91 having a bore smaller than that of the hole 87. The perforated member 82 is disposed in an enlarged diameter portion communicating to the hole 91. The constitution of other parts in this embodiment is as same as the above mentioned.

What is claimed is:

1. A construction of a control valve for an air suspension having main and auxiliary air chambers (14,16) comprising:

a boundary means (18) disposed between said main air chamber (14) and said auxiliary air chamber (16) and provided with a path for communicating both air chambers, the path including a first path portion (57) and a second path portion (58) having a bore smaller than that of the first path portion;

a perforated member (82) provided in relation with said second path portion (58) of said path; and

a valve body (20) disposed in said path for affording and interrupting communication between said main air chamber (14) and said auxiliary air chamber (16).

2. A construction of a control valve as claimed in claim 1, wherein said perforated member (82) has a plurality of holes extending in an axial direction of the second path portion (58,91).

3. A construction of a control valve as claimed in claim 1, wherein said second path portion (58) of said path is connected to a hole (59) having an enlarged bore and said perforated member (82) is disposed in the hole

(59).

4. A construction of a control valve for an air suspension having main and auxiliary air chambers (14,16) comprising:

a boundary means (18) disposed between said main air chamber (14) and said auxiliary air chamber (16) and provided with a path for communicating both air chambers;

a valve body (20) disposed in said path for affording and interrupting communication between said main air chamber (14) and said auxiliary air chamber (16), the valve (20) including a third path portion (87) and a fourth path portion (91) having a bore smaller than that of the third path portion; and

a perforated member (82) provided in relation with said fourth path portion (91) of said valve.

5. A construction of a control valve as claimed in claim 4, wherein said perforated member (82) has a plurality of holes extending in an axial direction of the fourth path portion (91).

6. A construction of a control valve as claimed in claim 4, wherein said fourth path portion (91) of said valve is connected to a hole having an enlarged bore and said perforated member is disposed in the hole.

7. A construction of a control valve for an air suspension which has main and auxiliary air chambers (14,16), both air chambers being formed to surround a shock absorber (22) comprising:

a boundary means (18) disposed between said main air chamber (14) and said auxiliary air chamber (16) and including a rigid member (50) to which a piston rod (26) of said shock absorber (22) is connected, a rubber bushing (52) disposed outside the rigid member (50) and a connecting member (30) disposed outside the bushing (52), the means (18) being provided with a path for communicating both air chambers extending through said rigid member (50), bushing (52) and connecting member (30), the path including a first path portion (57) and a second path portion (58) having a bore smaller than that of the first path portion;

a perforated member provided in relation with said second path portion (58) of said path; and

a valve body (20) disposed in said rigid member (50) of the means (18) for affording and interrupting communication between said main air chamber (14) and said auxiliary air chamber (16).

8. A construction of a control valve for an air suspension which has main and auxiliary air chambers (14,16), both air chambers being formed to surround a

shock absorber (22) comprising:

a boundary means (18) disposed between said main air chamber (14) and said auxiliary air chamber (16) and including a rigid member (50) to which a piston rod (26) of said shock absorber (22) is connected, a rubber bushing (52) disposed outside the rigid member (50) and a connecting member (30) disposed outside the bushing (52), the means (18) being provided with a path for communicating both air chambers extending through said rigid member (50), bushing (52) and connecting member (30);

a valve body (20) disposed in said rigid member (50) of the means (18) for affording and interrupting communication between said main air chamber (14) and said auxiliary air chamber (16) and provided with a path including a third path portion (87) and a fourth path portion (91) having a bore smaller than that of the third path portion; and

a perforated member (82) disposed in relation with said fourth path portion (91) of said valve.

Fig. 1

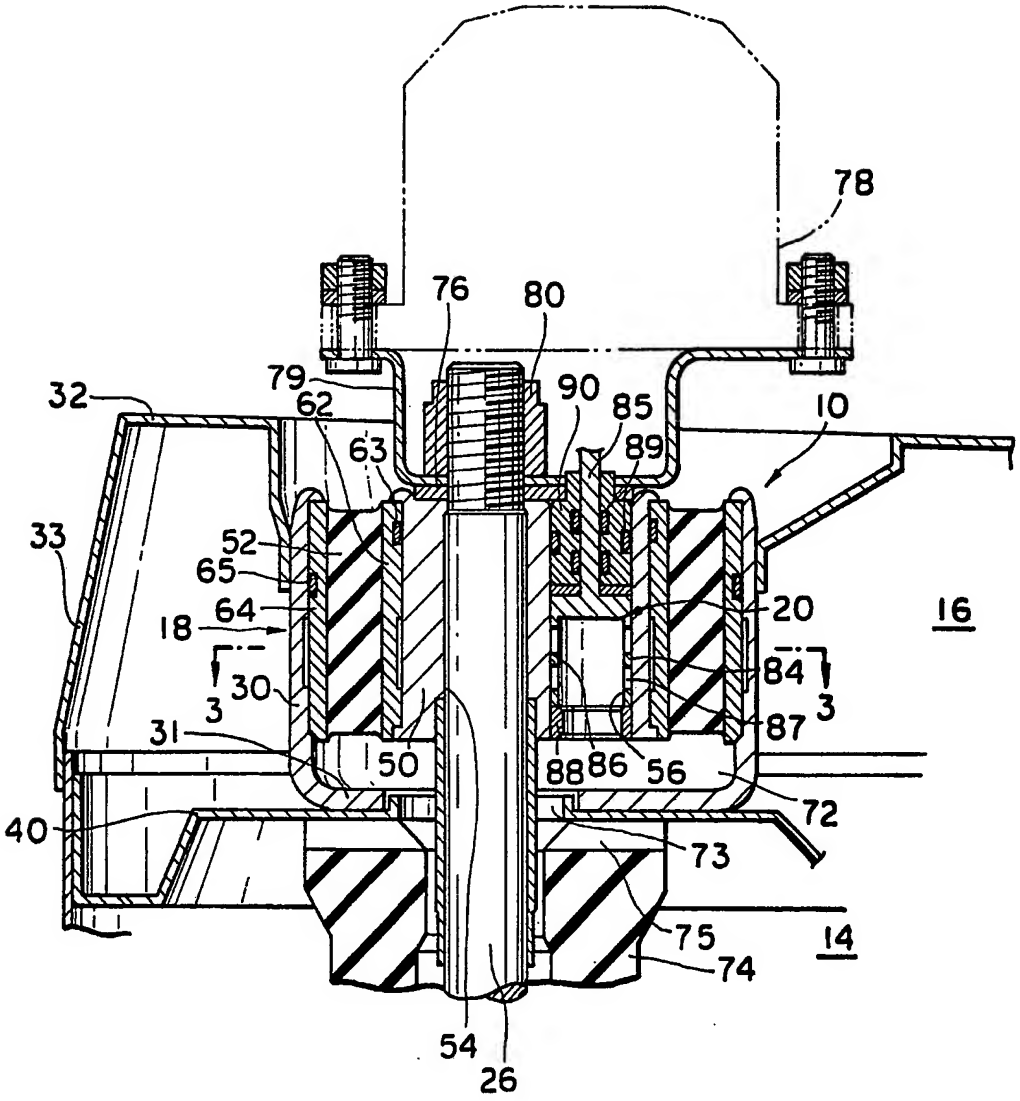
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Fig. 2

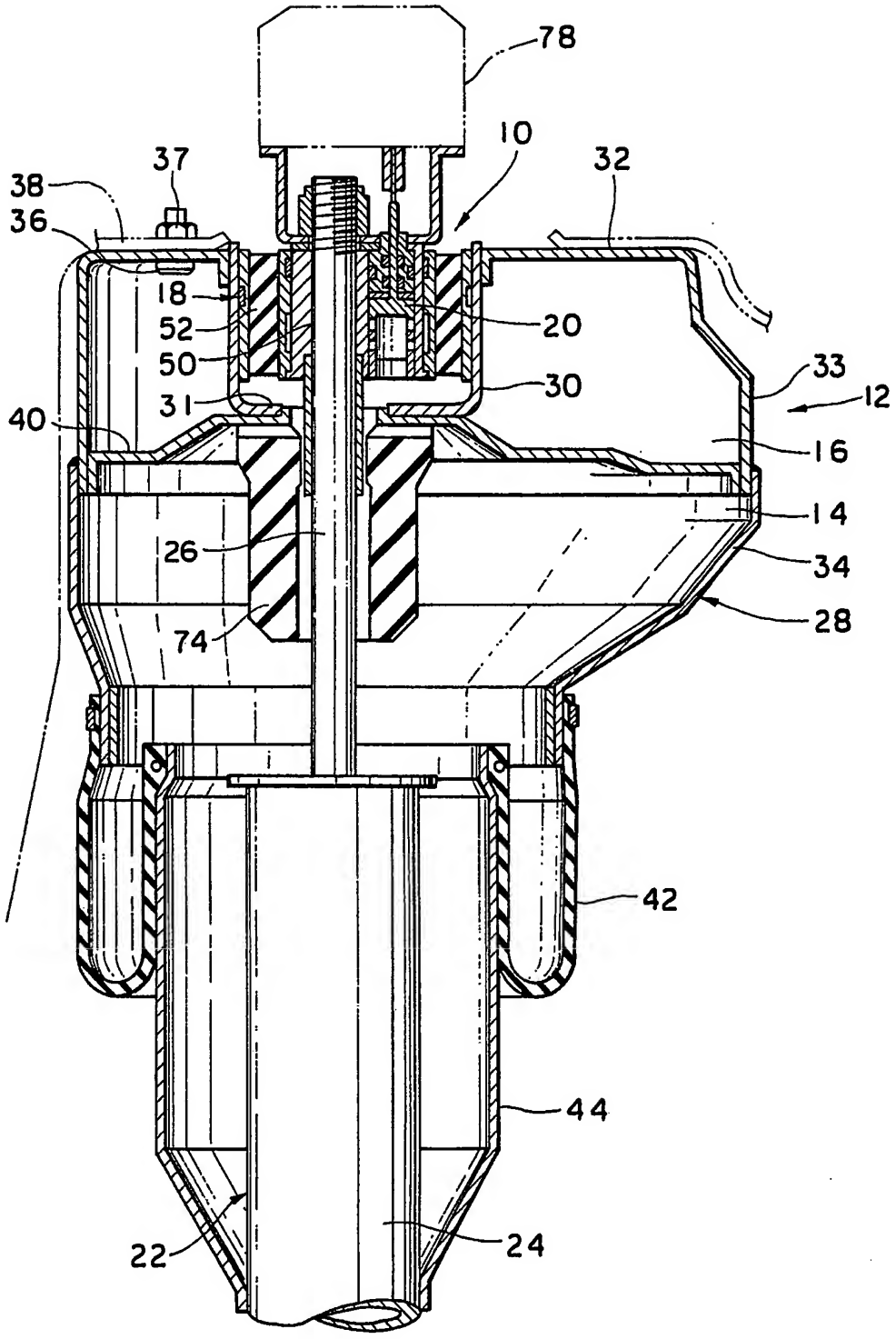
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Fig. 3

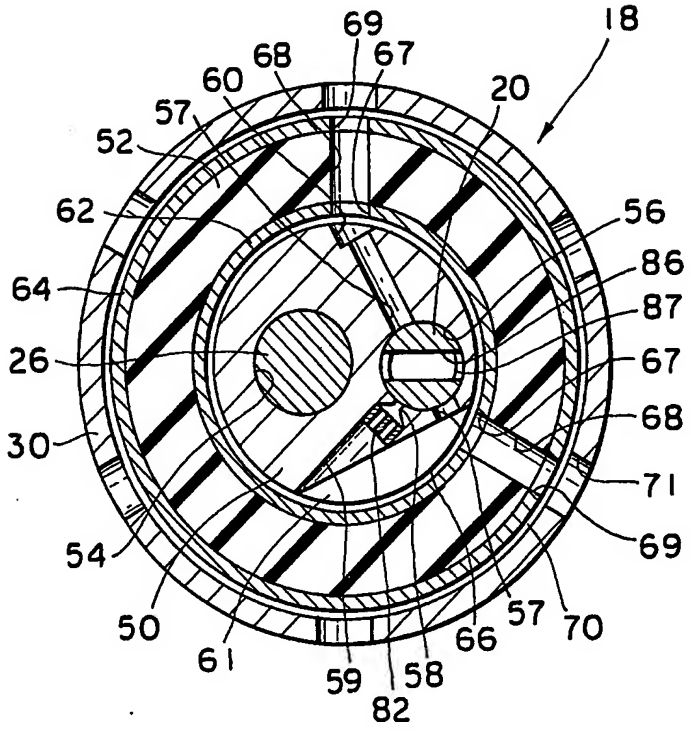
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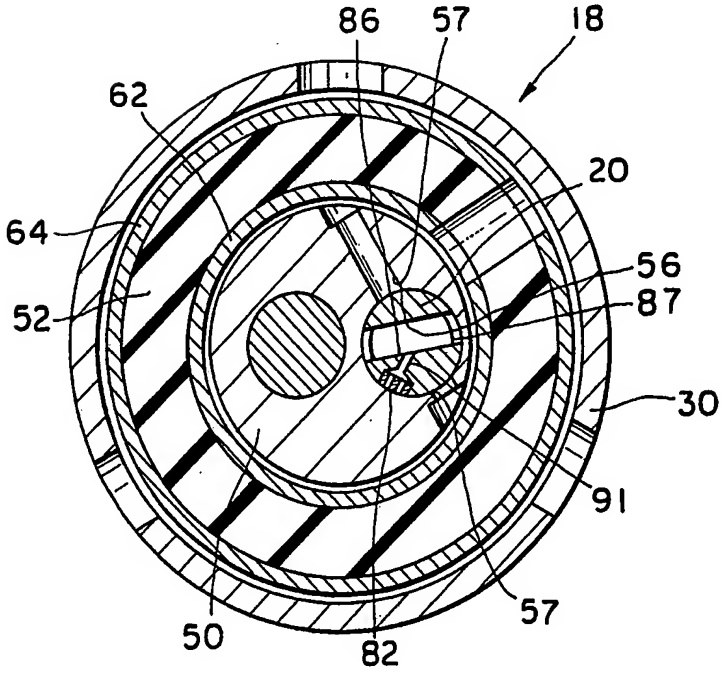
Fig. 4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